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Type of Organization: College or University

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Project Title: Extent Of Sediment Contamination in Lake Macatawa

Project Category: Contaminated Sediments

Rank by Organization (if applicable): 1

Total Funding Requested ($): 109,550 **Project Duration:** 1.5 Years

Abstract:

Lake Macatawa, Michigan has an extensive history of anthropogenic activity related to the direct discharge of industrial and domestic wastes. The shoreline of the lake was heavily industrialized and contained chemical, metal finishing, and leather tanning facilities. The proposed project will provide an assessment of the nature, extent, and ecological significance of sediment contamination in Lake Macatawa. The investigative sampling will primarily focus on regions of known sediment contamination in near shore areas and in deeper deposition zones. An initial series of 15 sediment cores and 15 Ponar samples will be analyzed for heavy metals, semivolatile organics, and physical characteristics. Ponar samples will also be analyzed for benthic macroinvertebrates and sediment toxicity. Since Lake Macatawa is a drowned river mouth system and many of the areas of contamination are in locations that are subject to resuspension by wave action, issues related to sediment stability and contaminant flux are important factors in the assessment of ecological significance and the development remediation plans. To address these concerns, 4 piston cores from near shore locations will be dated using 210-Pb and 137-Cs. In addition, these cores will be analyzed for a list of heavy metals that are present in the sediments of Lake Macatawa at significant levels.

The shoreline of Lake Macatawa is targeted for considerable economic development and habitat restoration activities. Information on the distribution and significance of contaminated sediments will play an important role in the restoration process of the lake. This project will also provide information on the fate and transport of contaminated sediments in drowned river mouth systems.

Geographic Areas Affected by the Project

States:

- ☐ Illinois
- ☐ Indiana
- ☒ Michigan
- ☐ Minnesota
- ☐ New York
- ☐ Pennsylvania
- ☐ Wisconsin
- ☐ Ohio

Lakes:

- ☐ Superior
- ☐ Huron
- ☒ Michigan
- ☐ Erie
- ☐ Ontario
- ☐ All Lakes

Geographic Initiatives:

☐ Greater Chicago ☐ NE Ohio ☐ NW Indiana ☐ SE Michigan ☐ Lake St. Clair

Primary Affected Area of Concern: Not Applicable

Other Affected Areas of Concern:

Problem Statement:

Lake Macatawa, Michigan is a medium sized drowned river mouth lake (1800 acres) that is directly connected to Lake Michigan by a navigation channel. The watershed has a drainage basin of 110,000 square miles and includes mostly agricultural lands. The lake is classified as hypereutrophic because of excessive phosphorous loading. Historically, significant anthropogenic activity has impacted the water and sediment of the lake. These discharges included effluents from organic chemicals (dyes and pigments), metal finishing, and leather tanning facilities. In addition, diffuse sources of contamination continue to enter the lake from tributaries, local runoff, and impacted groundwater plumes. There is, however, very little information on the current nature and extent of sediment contamination in the lake. In addition, the toxicity of these sediments and the integrity of the benthic macroinvertebrate community are unknown. The proposed project will provide a detailed investigation of the nature, extent, and ecological significance of contaminated sediments in Lake Macatawa. These data will be important to the EPA and MDEQ in the development of remediation plans for the lake and adjacent brownfield sites. This information will also be important for the determination of areas that may require further delineation and habitat restoration efforts. In addition, these data will serve as a basis for the prioritization of shoreline development activities by the community.

Since Lake Macatawa is subject to considerable sedimentation from its hypereutrophic status, the stability and mobility of bottom sediments is an important issue with respect to contaminant fate and transport. In consideration that many of the areas of contamination may be subject to wind and wave action, information related to sediment stability and mobility will be central to the development of remediation and restoration plans for the lake. Additionally, these data will further our understanding of the ecological significance of sediments that are mobile and subject to resuspension in drowned river mouth systems.

Proposed Work Outcome:

This investigation will examine specific sites of known anthropogenic activity as well as provide an overall assessment of the nature, extent, and ecological significance of sediment contamination in Lake Macatawa. This bifurcated approach will allow us to focus on specific areas based on historical information while we concurrently examine the broad-scale distribution and impacts of sediment contamination.

To address contamination at specific sites, we propose to collect 12 core samples from locations that have been impacted by anthropogenic activity. We will target historical discharge areas including outfalls, storm drains, and tributaries. In addition, areas receiving nonpoint contributions from runoff and contaminated groundwater will be investigated. Preliminary areas for core sampling include: Padnos Iron Scrap Yard, Holland Machine Brownfield Site, former Holland Municipal Landfill, BASF/Holland Color RCRA Site, former Holland Tanning Works (Parke Davis/Pfizer), Donolley Corp groundwater

plume, Pine Creek basin and Kollen Park Drain. In addition to samples from these areas, three cores will be collected in deeper deposition zones located in the middle of the lake. These core samples will be analyzed for heavy metals (arsenic, cadmium, copper, chromium, lead, mercury, nickel, and zinc), semivolatile organics, total petroleum hydrocarbons, and physical characteristics (grain size distribution, TOC, bulk density, and percent solids). Ponar samples will also be collected at the same locations and analyzed for chemistry, sediment toxicity, and benthic macroinvertebrates. The Ponar samples will provide supplemental information on the surface zone chemistry and help characterize the sediment toxicity and benthic macroinvertebrate populations in this area of contamination. The final location of the core and Ponar samples will be determined in cooperation with the MDEQ and USEPA. Core samples at the above locations will be collected by VibraCore techniques using the R/V Mudpuppy. This part of the project will provide historical and current information related to the nature and extent of sediment contamination in Lake Macatawa. The benthic macroinvertebrate and toxicity evaluations will support this information and be used for evaluating ecological effects and prioritizing areas for remediation.

In addition to the above scope of work, an investigation of sediment deposition and stability will be conducted using radiodating and detailed stratigraphy. Radiodating profiles will help define annual deposition rates and directly reflect sediment stability. In consideration of the effluent diversions that occurred in early 1970s, heavy metal flux into Lake Macatawa have presumably declined dramatically over the last 25 years. If the sediments are stable and not subject to resuspension, lower levels of heavy metals should be encountered in the surface strata. To help assess the stability and deposition of sediments in Lake Macatawa, 4 piston cores from near shore locations will be collected and dated using 210-Pb and137-Cs. The locations of these samples and the target chemistry list will be determined after reviewing the initial sediment chemistry data. In addition to radiodating, each core will be assayed rapidly at 2-cm intervals by Particle Induced X-ray Emission (PIXE) spectroscopy to develop a detailed stratigraphic profile of both major elements and trace metals. Ten percent of these core samples will be further analyzed by standard digestion and ICP analysis to confirm metal content and to quantify any metals of concern that may fall below PIXE detection limits. The radionuclide and heavy metal profiles in the near shore areas will be used to determine if the sediments are stable or mixed by wave action. Data from the deeper cores will be used to assess the mobility of sediments in the lake. If the near shore sediments are subject to mixing, contaminated materials from historic discharges may be moved to the surface and result in a long-term impairment of ecological conditions. The information from the deeper cores will determine if significant levels of heavy metals are still mobile in the lake from the effects of wave action and from currents related to the drowned river mouth system. These data along with the biological and toxicological studies discussed above will provide a technically sound basis for the development of remediation alternatives and restoration plans for Lake Macatawa.

Project Milestones:	Dates:
Project Start	10/2001
Sample Collection	11/2001
Complete Initial Analyses	04/2002
Collection of Cores for Radiodating	05/2002
Complete Radiodating and Stratigraphy	10/2002
Review and Analyze Project Data	11/2002
Begin Final Report	12/2002
Complete Final Report	04/2003

☐ Project Addresses Environmental Justice

If So, Description of How:

☒ Project Addresses Education/Outreach

If So, Description of How:

In order to address community concerns and to build public support for issues related to contaminated sediments, the Macatawa Area Coordinating Council (MACC) will conduct an outreach education program as part of this project. The MACC is local organization of over 500 partners from the public and private sectors that are committed to a voluntary, community based, program to improve the Lake Macatawa watershed. The outreach materials and activities will be consistent the MACC's ongoing Information and Education program and include:

1. The production and distribution of articles in the MACC's newsletter and on their public web site concerning the purpose and anticipated outcome of the project, the beneficial use impairments related to contaminated sediments, and how the information can be used for community decision making.

2. Development of an internet base display board for the Lake Macatawa project that will include photographs, maps, data summaries, and information concerning the ecological significance of contaminated sediments. The internet based information will be part of the current MACC web site and be consistent with format and content.

3. Coordination and hosting of a Public Meeting designed to disseminate the project results and solicit community input. The MACC will provide the necessary advertising and publicity for the meeting, develop the agenda, and cover the costs for the room and food service.

Project Budget:

	Federal Share Requested ($)	Applicant's Share ($)
Personnel:	36,550	0
Fringe:	9,666	0
Travel:	1,000	0
Equipment:	0	0
Supplies:	7,000	0
Contracts:	44,000	0
Construction:	0	0
Other:	0	0
Total Direct Costs:	98,216	0
Indirect Costs:	11,334	5,766
Total:	109,550	5,766
Projected Income:	0	0

Funding by Other Organizations (Names, Amounts, Description of Commitments):

Description of Collaboration/Community Based Support:

This project will be performed in collaboration with the following scientists and organizations as co-investigators and contractors:

-Dr. Graham Peaslee, Hope College. Radiodating and Metals analysis
-Dr. Peter G. Meier, University of Michigan. Benthic Macroinvertebrate Ecology
-Ms. Susan Higgins, Macatawa Area Coordinating Council. Outreach Education.

Other potential partners for this project may include the City of Holland, MDEQ, and the US Army Corps of Engineers. The project will assist in the development of remediation plans for contaminated sediments in Lake Macatawa. It will also support the evaluation and prioritization of shoreline development and habitat improvement programs that are under consideration by local units of government, citizen groups, and the business community.